IMAGE CAPTURE DEVICE DOOR MECHANISM

PRIORITY

The present application claims priority from co-pending provisional patent application serial number 60/413,079, Filed on September 23, 2002, entitled IMAGE CAPTURE DEVICE and co-pending provisional patent application serial number 60/450,304, Filed on February 27, 2003, entitled IMAGE CAPTURE DEVICE DOOR MECHANISM.

FIELD OF THE INVENTION

The present invention relates to image capture devices and more particularly, to a lens door mechanism for an image capture device.

BACKGROUND OF THE INVENTION

There is an interest in making cameras more compact. In order to do so, certain parts on the camera can be designed to take up less space.

What is needed is to an image capture device that has been designed to be compact. What is further needed are image capture device components that require less space in or on the image capture device to work.

SUMMARY OF THE INVENTION

A door opening mechanism for an image capture device is provided which translates non-linear motion into a linear motion used to open or close the lens door.

In one particular embodiment, rotary motion is translated to the linear up and down motion of the lens door.

In another embodiment, the pendular motion of a door control grip is translated to the linear up and down motion of the lens door.

Other particular features and embodiments will become apparent from the following detailed disclosure of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of the preferred embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings an exemplary embodiment that is presently preferred, it being understood however, that the invention is not limited to the specific methods and instrumentality's disclosed. Additionally, like reference numerals represent like items throughout the drawings. In the drawings:

Fig. 1 is a perspective view of an image capture device in accordance with one embodiment of the present inventions.

Fig. 2 is a front plan view of the image capture device of Fig. 1.

Fig. 3 is a front plan view of the image capture device of Fig. 1 wherein the lens cover has been opened to expose the lens and viewfinder front apertures.

Fig. 4 is a rear plan view of an image capture device in accordance with one particular embodiment of the present inventions.

Fig. 5 is a top perspective view of an image capture device in accordance with one embodiment of the present invention having parts removed to more clearly see features of one embodiment.

Fig. 6 is an enlarged view of a portion of Fig. 5.

Fig. 7 is a top partial perspective view of an image capture device in accordance with one embodiment of the present inventions having parts removed to more clearly see features of one embodiment

Figs. 8 - 28 are described herein.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before explaining the disclosed embodiments of the present invention in detail, it is to be understood that the invention is not limited in its application to the details of the particular arrangement shown since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.

The Image Capture Device Housing

Referring now to Fig. 1 - 5, there is shown an image capture device 10 made in accordance with one particular embodiment of the present invention. Image capture device 10 includes a front housing 12 and a rear housing 14 that matingly engage to surround the internal workings of the image capture device 10. A compartment door 15 may engage either or both of the front and rear housings 12 and 14 to provide access to a battery compartment and/or to output connectors. Such output connectors may be used to connect the image capture device 10 to an external device such as a television, a computer a printer, a cell phone, etc.

Front housing 12 of image capture device 10 includes a plurality of apertures formed therethrough, such as a taking lens/viewfinder window 12a, an aperture 13 for a red eye reduction mechanism and a flash window 18. As shown in Fig. 3, when the lens door 16 is opened, the taking lens aperture 17a and viewfinder aperture 17b of the lens mask 17 are exposed.

Rear housing 14 additionally includes a plurality of apertures therethrough. For example, the rear housing 14 of the present particular embodiment includes openings a rotary switch 24, nested tactile switch 26, a rotary diopter adjustment knob 28, an LCD display 30 a view finder rear aperture 32 and signal indicators 34. Other user interface devices, buttons and switches may be included.

A battery door 15 extends across an aperture through a side face of the image capture device 15.

Rotary On/Off Switch With Nested Release Button

Referring more specifically to Figs. 5 – 6, front housing 12 additionally includes an aperture 12b and release shaft opening 12c. A cylindrical bearing shaft post 12d and three fastener posts 12e additionally extend from the upper surface 11 of the front

housing 12. Bearing shaft post 12d includes a rectangular key opening 12f, therethrough. Door control pin 45a extends through the aperture 12b.

The nested switch assembly 21 is secured to the camera in a novel manner as will be described in connection with Figs. 6 – 10. First, referring to Fig. 7, the rotary on/off switch gear 20 is located around the cylindrical bearing shaft post 12d on the top surface 11 of the front cover 12 and a hole 20b on the underside of the rotary on/off switch gear 20 is lockingly engaged with the door control pin 45a of a door connector (45 of Fig. 14). The fastener posts 12e pass through openings 20d in the rotary on/off switch 20. Openings 20d additionally include enough space to accommodate fastener posts 12e when the gear 20 is moved in the direction of arrow X, without permitting the gear 20 to be overdriven or turned in the wrong direction. Further, the rotary on/off switch gear 20 includes openings 20e and 20f spaced 35 degrees apart, which will engage an on/off detent mechanism, as will be described in connection with Fig. 8. Although the present particular embodiment shows the openings 20e and 20f as being 35 degrees apart, it can be seen that the system could be adapted to have the openings different distances or angles apart, and the detent spring 60 of Fig. 8, could be likewise adapted. The on/off detent positions of the switch 20 are accomplished using a detent spring finger that moves in and out of two slots of the lens door gear, as will be described more specifically in connection with Figs. 7 and 8.

Referring now to Figs. 7 and 8, an on/off detent spring 60 sits on top of the inner circumference of the rotary on/off gear 20. On/off detent spring 60 has holes 61 that align with holes in the posts 12e (Fig. 6). Additionally, the on/off detent spring 60 includes a spring finger 62. When the rotary on/off switch gear 20 is in an initial position (i.e. the off position), the detent spring finger 62 rests in the opening 20f of the rotary on/off switch gear 20, capturing the switch gear 20 in the off position. When the rotary on/off switch gear 20 is turned in the direction of arrow X, the detent spring finger 62, which is maintained stationary due to screws (74 of Fig. 9) securing them to the top face 11 of the front housing 12. However, when the gear 20 is rotated into its second position (i.e. the on position), the gear 20 rotates about the bearing shaft post 12d in the direction of arrow X, and the detent spring finger 62 is captured by the gear 20 in opening 20e.

Thus, the switch has two distinct detent positions. It can be seen how other additional switch positions may be added.

Further, as the gear knob 20a, and correspondingly the gear 20, is rotated, the door control pin 45a captured in the hole 20b is moved linearly along the slot 12b. Moving the door control pin 45a moves the door connector (45 of Fig. 14) correspondingly. When the door controller 45is moved between a first and a second position, a conductive wiper (47 of Fig. 14) is also moved between a first and second position, providing a signal to the processor (not shown) that the rotary on/off switch 21 has moved from an "off" position to an "on" position or vice versa.

Referring now to Fig. 9, sitting on top of the on/off detent spring 60 is a release button spring 70, which acts as additional capturing support for the release button 22 and on/off switch gear 20, as well as provides the vertical spring force to the release button 22. In one preferred embodiment, both flat springs 60 and 70 are being held down by screws 74, although other pins or heat stake elements would work as well. The screws or pins are secured to the three posts 12e formed on the top face 11 of the front housing 12.

The release button spring 70 includes three leaf spring legs 72a, 72b and 72c. The leaf spring legs 72a, 72b and 72c extend upward from the plane containing the detent spring, within the rotary on/off switch gear 20. The upper surfaces of the leaf spring legs 72a, 72b and 72c contact the release button 22, when installed and return the release button 22 to its normal position after the consumer has depressed the button 22, when capturing an image. As with the on/off detent spring 60, the release button spring 70 includes three screw openings 71 aligned with the openings 61 of the on/off detent spring 60 so that the screws 74 pass through and secure the release button spring 70 to the top surface 11 and so that the release button spring resists rotational forces when the rotary on/off switch gear 20 is turned.

Referring now to Figs. 9 – 13b, there. The release button 22 includes a shaft 82 and a key 84. The shaft 82 and key 84 fit into the opening 12c in the post 12d, with the key 84 fitting through the rectangular key slot 12f. By turning the release button 22 clockwise, the release button is held downwards by interconnection of the upper key surface to the lower front shell hole surface. Turning the release button 22 further, one

release spring leg 72b of the release button spring 70 will interlock with a track 86 on the lower surface of the release button 22. The release button 22 is now permanently captured in the vertical direction and is protected against movement in the rotational direction. The three leaf spring legs 72a, 72b and 72c of the release button spring 70 will push the button upwards. The lowest surface 88 of the release button shaft 84 will push against and activate a tactile switch 87 on the PCB 89 or other switch device. As such, once the release button 22 shaft 84 is inserted through the bearing surface 12d and is rotated clockwise with the key 84 no longer aligned with the key slot 12f and the leaf spring 72b is trapped in the track 86, the release button 22 is locked into the housing without the need for a "c" ring and corresponding groove on the stem 84.

The Rotary to Linear Door Linkage Mechanism

One particular embodiment of the door opening mechanism will now be described in connection with Figs. 13a – 17. The door opening mechanism of the present embodiment translates the rotary motion of the rotary on/off switch gear 20 to the linear up/down motion of the lens door 16. As described above, the door controller 45 is engaged with the rotary on/off switch gear 20 via the door control pin 45a. To secure the open and closed end positions of the lens door 16, a spring biased lever is used.

A lever 50 is attached between the door controller 45 and the lens door 16 by means of a series of bends on the lever 50 and the door 16. More specifically, a finger 52 of lever 50 is connected to body portion 50a of the lever 50 at a bend portion. Similarly, the finger 55 is connected to an arm portion 50c of the lever 50 by a bend portion. The lens door loop 26b has a corresponding bend to facilitate mating with the finger 55. Two other bends 19 of the lens door slide portion 16c interact with the lens door mask (not shown) and build a guide rail mechanism for the up and down motion of the lens door 16.

The present door lever mechanism has an incorporated spring arm 54, which is part of the lens door lever 50. During lens door motion, a wedge portion 54a of the spring arm 54 moves over a roller 58 to reach two different end positions and provide an "over the center" approach to ensuring two discrete opened and closed positions of the lens door 16. Spring portion 54 is attached to lever body portion 50b.

The pre-load of the spring portion 54 (linked through the bends on the lens door and the activation lever by the two end positions of the spring) secures the open and closed positions of the lens door 16. The lens door lever 50 has a bearing connection through a pin 56 of the lens door that is captured by a thin washer. As such, the door lever 50 pivots around the pin 56 in response to motion of the finger 52, connector 45 and rotary switch gear 20. The pivoting of the lever 50 serves to slide the ribs 19 in the guide track and open or closed the lens door 16. Ribs 19 may be formed in or punched from the guide portion 16c, or may comprise another material affixed to the guide portion 16c. The spring wedge 54a passing over the roller 58 from one side to the takes over the opening or closing of the door after the initial turn of the rotary switch gear 20. The lens door 16 is fixed open or closed depending upon which side of the roller 58 the wedge 54a stops. The roller 58 may be fixed to the front cover 12 or to a part or mask adjacent the front cover 12 (as is shown in Fig. 20 in connection with another embodiment of the present invention).

The present particular embodiments shown in Figs. 15 – 18 are additionally shown including a damage protection mechanism to prevent the lens door 16, the door lever 50, 90 or the switch connector 45, from being damaged if the lens door 16 is manually forced open by the user. Located within two opposite slots of the lens door connector 45 are two lens door guide pins 41a and 41b located coaxially within the springs 40a and 40b. The guide pins 41a and 41b and springs 40a and 40b are maintained in place in the slots of the connector 45 by two side walls 45b which are heat staked to the connector 45. The rounded lens door lever finger 52 engages the connector 45 between the two lens door guide pins 41a and 41b. Interacting with the bottom surface of the lens door connector 45 on the lens door lever 50 are two radial shaped fingers 53, which are locked into position by the bent surface adjacent the finger 52 formed on the lens door lever 50. The rounded surface portions of the fingers 53 help to guide the lens door connector 45 towards the front lens door surface 16a.

The door springs 40a and 40b and guide pins 41a and 41b in combination act as a lens door part damage prevention device. In event that the lens door is being forced open, the springs 40a and 40b would retract and allow the lens door lever 50 and lens

door 16 to move freely. This damage prevention would also act similar if the lens door knob 20a were rotated (clockwise or counter clockwise) while the lens door was being opened or closed by force.

Referring now to Fig. 18, there is shown an alternate embodiment of the rotary to linear door linkage mechanism using an omega type spring 95 to accomplish the two discrete positions of the door lens 16. Whereas the remainder of the parts are essentially the same as described in connection with Fig. 15, the lever 90 differs from the lever 50 such that the lever 90 does not include an integral spring portion. Rather a spring 95 with two end loops, similar to an omega spring function, interacts between a pin 98 connected to the front cover 12 (or a part adjacent the front cover 12) and a hook 97 on the lens door lever 90. When the gear 20 is rotated to the "on" position, the lever 90 and spring 95 are rotated, biasing the door 16 into the open position as described above in connection with the embodiment of Fig. 15. When the switch gear 20 is rotated back to the initial position, the lever 90 is rotated, rotating the spring and biasing the door into the closed position. The present embodiment could be adapted to use other types of springs, such as a hooked coil spring, a torsion spring, etc.

The Pendular to Linear Door Linkage Mechanism

A door opening mechanism will be described that translates the pendular motion of the grip 120 to the linear up and down motion of the lens door 16'.

Referring now to Fig. 19 - 26, there is shown the front shell 12' of an image capture device made in accordance with another particular embodiment of the present invention. Front shell 12' includes a plurality of apertures formed therethrough, such as a taking lens/viewfinder window 12a' and a flash window 18'. As shown in Fig. 21, when the lens door 16' is opened, the taking lens aperture 17a' and viewfinder aperture 17b' of the inner lens door cover 17' and an aperture 13' for a red eye reduction mechanism are exposed. Instead of having the rotary door-open/on/off switch (20 of Fig. 6) and nested release button described in connection with the above embodiments, the present particular embodiment uses a more direct method of opening and closing the lens door. Thus, the release button may be seated directly into the housing, instead of nested into a rotary switch.

Disposed on the surface of the front shell 12', in the present particular embodiment, is a crescent shaped grip 120. Located beneath the grip 20' and through the housing 12' is a track (not shown) that permits the grip 120 to be rotated from a first position in which the lens door 16' is closed to a second position, in which the lens door 16' is open. In the present particular embodiment, the grip 120 is rotated in the direction of arrow A' to open the lens door 16' and in the direction of arrow B' to close the lens door 16. Additionally, in the present particular embodiment, rotating the grip 120 in the direction A' additionally turns the camera on, while rotating the grip 120 in the direction of arrow B' turns the camera off.

Located between the front shell 12' and the inner lens door cover 17' is the mechanical door mechanism of one embodiment of the present invention. The grip 120 accessible from outside the front shell 12' is affixed to the free end of a pendular lever 130 sandwiched between the inner surface of the front shell 12' and the inner lens door cover 17'. The other end of the pendular lever 130 is pinned to the inner cover 17' by a rivet, pin, or head stake 135.

The pendular lever 130 is additionally attached to the lens door lever 140. A bearing pin 145 on the lens door lever 140 is engaged with an ovoid shaped slot 130a on the pendular lever 130. The walls of the slot 130a are angled conically towards the lens door lever to allow for a 3D conical motion of the pendular lever within the mechanism. Corresponding conical surfaces on the front shell 12' and the conically shaped parts (pendular lever slot 130 and crescent grip 20') and the pin 145 to slot 130a bearing arrangement enables three dimensional motion of the pendular lever 130/crescent grip 120 to the lens door lever 140.

The lens door lever 140 is attached to the lens door 16' by means of a series of bends on the lever 140 and the lens door 16'. In response to rotary motion of the pendular lever 130, the lens door lever 140 seesaws around the pivot point formed by the pin 145. A finger 142 of lever 140 is connected to body portion 140a of the lever 140 at a bend portion. The lens door 16' includes a loop 16a', which has a corresponding bend to facilitate mating with the finger 142. Additionally, a slot 16b' on the lens door interacts with a guide rib 17c' on the inner door cover 17' to ensure the straight up and

down motion of the lens door 16' when the lens door lever 140 is rotated in response to rotation of the grip 120 and pendular door lever 130. Further, a lens door guide pin 150 is fixed to the lens door 16'. The guide pin 150 slides within a slot formed of guide rails (not shown) in the front shell 12' to additionally ensure that the lens door 16' maintains a straight up and down motion.

Additionally, the lens door lever 140 of the present embodiment has an incorporated spring arm 154, which is part of the lens door lever 140. During lens door motion, a wedge portion 154a of the spring arm 154 moves over a roller 165 to reach two different end positions and provide an "over the center" approach to ensuring two discrete opened and closed positions of the lens door 16'. Spring portion 154 is attached to lever body portion 140a.

The pre-load of the spring portion 154 (linked through the bends on the lens door and the activation lever by the two end positions of the spring) secures the open and closed positions of the lens door 16'. Due to the bearing connection between the lens door lever 140 and the pendular lever 130, and the fixed portion of the pendular lever at the pin 135, rotary motion of the grip 120 in the direction of arrow A' or arrow B', pivots the lens door lever 140 around the pin 145 and, in response to the force and motion of the finger 142 pulling the lens door loop 16a', serves to slide the lens door 16' into the open or closed position. Simultaneously, by action of the spring arm 154, the spring wedge 154a is passed over the roller 165 from one side to the other and the resulting forces fully open or close the lens door after the initial turn of the crescent grip 120. The lens door 16' is fixed open or closed depending upon which side of the roller 165 the wedge 154a stops.

To further retain the lens door 16' in the up or down position, a detent mechanism 170 is additionally affixed to the pendular lever 130. The detent mechanism 170 is spring biased to lock the end portion 170a into one of the indentations 175 and 177 in the inner surface of the front shell 12' when the pendular lever 130 is rotated by the grip 120. This interaction locks the lens door pendular lever 130 into one of two discrete positions for opening or closing the lens door 16' and prevents the pendular lever from drifting during

use. As it takes a force to move the detent mechanism 170 out of the indentations 175 and 177, only an affirmative force on the grip 120 will open or close the lens door 16'.

Additionally, as noted above, the pendular door mechanism of one particular embodiment of the present invention is additionally used to turn the camera on and off. The lens door lever 140 additionally includes and arm portion 140b that is pivotally connected to a slide switch 180. Referring more particularly to Figs. 27 and 28, slide switch 180 operates a toggle lever 190 of an electrical switch 1100 on a PCB 1110 disposed behind the lens door lever 140 into one of two possible positions corresponding to the on and off positions of the camera. Alternatively, metallic fingers may be attached to the slide switch 180 so that motion of the lever 140 from one position to another causes the slide switch 180 to contact traces on a PCB located behind the slide switch and open or close a circuit to turn the camera on or off. It can be seen that interaction between the detent mechanism and the indentations 175 and 177 additionally defines the camera on and off positions.

While the invention has been described with reference to certain embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. For example, the lens door lever can be modified to omit the spring arm and roller and could be adapted to use other types of springs, such as a hooked coil spring, a torsion spring, etc. to achieve the same type of locking force. In addition, many modifications can be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.